REMARKS

Status of Claims

Claims have been amended to attend to formalities pointed out by the Examiner. New claim 35 finds support in the original specification at page 8, paragraph [00017] at lines 1- 5 there, and page 9, paragraph [00019](lines 1-4).

Claim Objections - 35 USC § 112

Claim 22 objected to because of the following informalities: the term "posses" appears to be a misspelling of the word "possess". Appropriate correction is required.

Applicants have corrected the spelling

Claim 28 objected to because of the following informalities: "foreseen" does not make sense in the context of the claim. It appears that the likely intention was that the alignment marks are "visible" on the layer elements. Appropriate correction is required.

Claim 28 has been carefully revised.

Claim Rejections - 35 USC § 112

Claims 18, 19, 21, 22, 24, 25, 28, and 30-33 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Regarding claim 18, the phrase "such as" renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention. See MPEP § 2173.05(d)

The term "basically" in claim 19 is a relative term which renders the claim indefinite. The term "basically" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. It is unclear how much of the layers comprise silicon or silicon compound alloy. The tern "basically" in claim 24 is a relative term which renders the claim indefinite. The term "basically" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. It is unclear how much of the layer elements are comprised of electrically conducting material.

Claims 21 and 22 recite the limitation "the surface of the cavities" and "the surface of

the inner cavities". There is insufficient antecedent basis for these limitations in the claims.

Claim 25 recites the limitation "the substrate" in line 3 of the claim. There is insufficient antecedent basis for this limitation in the claim. The claim also uses the term "basically".

Claim 28 recites the limitation "additional alignment marks' in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 30 recites the limitation "the surfaces of the etched cavities" in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 31 recites the limitation "the surfaces of the etched cavities" in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 32 recites the limitation "the reactants" in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim. The claim also uses the phrase "such as" which renders the claim indefinite.

Claim 33 recites the limitation "the reactants" in line 2 of the claim. There is insufficient antecedent basis for this limitation in the claim. The claim also uses the phrase "such as" which renders the claim indefinite.

Claim Rejections - 35 usc g 102

Claim 18, 19, 22, and 24 is rejected under 35 U.S.C. 102(b) as being anticipated by Lehmann(US Patent 5,262,021). Lehmann discloses a workpiece that comprises pores etched perpendicularly through a single substrate layer (see column 1, lines 37-41). Lehmann further teaches that the workpiece can be used as a catalyst support (see column 1, lines 913). Regarding Claim 19, Lehmann teaches that the layer comprises silicon (see column 1, lines 37-41). Regarding Claim 22, Lehmann teaches that the dimension of the pores can vary from 20 pin to 50nm. (See column 2, lines 33-36) Regarding claim 24, Lehmann teaches that the silicon layer comprises n-doped silicon (see column 1, lines 37-44).

In response, Applicant has carefully reviewed and revised the claims to attend to each point raised by the Examiner.

Claim Rejections – 35 USC §103

Claims 18-24, 32-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over

According to the Examiner, Lehmann(WO 99/061147) (referred to herein as the US equivalent patent Lehmann (US Patent 6,887,437)) and further in view of Ashmead (US

Patent 5,534,328). Lehmann teaches a reactor comprising a porous silicon substrate that is used as a catalyst support. The silicon substrate comprises a first and second main surface and holes extending perpendicularly and traversing from the first main surface to the second main surface (see Lehmann US Patent 6,887,437, column 1, lines 40-53). Lehmann does not teach a reactor where silicon substrate comprises layers. Ashmead teaches an apparatus for chemical processes that comprises a plurality of laminae with one or more channels on each lamina (see column 2, lines 58 to 64). The layers of laminae, as taught by Ashmead, allow macroscale production with microfluidic scale chemical kinetics, turbulent mixing, and compartmentalization. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the porous-silicon substrate as ttaught by Lehmann with multi-laer architecture to achieve macroscale production as taught by Ashmead as Ashmead teaches that the laminae provide for large-scale production.

Regarding Claim 19, Lehmann further teaches that the substrate comprises silicon as the substrate material (see column 1, lines 40-53). Ashmead further teaches that the lamina comprises silicon (see column 6, lines 31-36).

Regarding Claim 20, Lehmann further teaches a substrate comprising holes with the dimensions from 1um to 10 sm (see column 2, lines 1-2).

Regarding Claim 21-22, Lehmann further teaches that the inner surface features of the substrate can be coated with metal catalysts and with an intermediate inert layer comprising metal silicides (see column 2, lines 34-42). Ashmead also teaches that catalytic materials can be deposed into the surface of channels (see column 7, lines 53-56)

Regarding Claim 23, Ashmead further teaches that silicon wafers can have alignment indicia (see column 15, lines 30-34).

Regarding Claim 24, Lehmann further teaches that the substrate is n-doped silicon which is electrically conductive (see column 4, lines 42-45).

Regarding Claim 32, Lehmann further teaches that the reactor comprises an exterior housing with the porous silicon wafer disposed within the housing The . Th housing further comprises a first and second feed disposed on opposite sides of the wafer so that reactants can be fed into the reactor or withdrawn (see column 1, lines 49-53 and column 2; lines 17- 29)

Regarding Claim 33, Ashmead further teaches that the apparatus can be replicated and can be joined in sequential and/or tandem operation depending on the desired operation parameters (see column 7, line 62 to column 8, line 4).

Claim 25-31, and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lehmann (WO 99/061147) (referred to herein as the US equivalent patent Lehmann(US Patent 6,887,437) and further in view of Ashmead(US Patent 5,534,328). Lehmann teaches a method of fabrication of a highly perforated workpiece having holes extending perpendicular to a first surface of the workpiece, the method comprising the steps of etching a substrate silicon wafer to produce holes extending through the wafer. Lehmann does not teach the stacking of the equally processed wafers to produce an integral structure.

Ashmead teaches the stacking of etched silicon wafers and the bonding of the wafers to produce an integral structure. Formation of an integral structure allows it to be used as chemical reactor capable of macroscale production of chemicals yet taking advantage of microscale chemical kinetics and compartmentalization. It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the highly porous workpiece with stacking of the workpieces to produce an integral structure capable of macroscale production as taught by Ashmead.

Regarding claim 26, Lehmann further teaches a method of fabrication where the etching is accomplished by deep anodic etching or photo anodic etching (see column 4, lines 42-54).

Regarding Claim 27, Ashmead further teaches that the fabrication of the lamina is accomplished by known semiconductor processing techniques for silicon wafers. Ashmead further teaches the fabrication of the lamina by anisotropic etching techniques. At the time the invention of the present application was made, plasma etching was a well known semiconductor processing technique known for etching highly anisotropic features. It would have been obvious to one of ordinary skill in semiconductor processing at the time of the invention to fabricate the porous silicon by plasma etching.

Regarding Claim 28, Ashmead further teaches the addition of alignment indicia to the silicon wafers to ease the alignment of layers (see column 15, lines 30-34).

Regarding Claim 29, Lehmann further teaches a method of fabrication where the etched surface is pre-patterned by a photo-lithographic process (see column 5, lines 23-28).

Regarding Claims 31, Lehmann and Ashmead both teach that the holes or channels can be coated with a catalyst (see Lehmann column 2, lines 34-42 and Ashmead column 7, lines 53-56)

Claim 34 merely discloses an intended use of the catalytic reactor to reform feed fuels

to a fuel cell.

Response

In the by the Examiners raised patent No **US 5,262,021** the author V.Lehmann teaches the general method of electrochemical etching, so called deep anodic etching of pores in a silicon substrate. As one of several possible applications a catalytic reactor is mentioned without any detailed description.

The applicants of the present patent have therefore changed title and claims to focus the present invention to its main application, a microstructured hydrogen reforming reactor and its fabrication method. This is the envisaged device for which the patent has been filed for. A hydrogen reforming reactor is not included in the claims of the patents of V.Lehmann and Ashmead.

Therefore the claims of the raised patents do not conflict with the claims of the present patent the title and claims of which have been accordingly changed. The fabrication method of its catalyst body is comprised in the claims but is not the main innovation of this patent.

Applicants have drawn two figures to make the 2 variants of combining or stacking of the processed reactor segments clear.

Claim 18 of the present patent comprises the fabrication of the catalyst body in an hydrogen reforming reactor which converts hydrocarbons by e.g. a catalytic oxidation and reforming reaction to hydrogen and carbon monoxide in a catalyst body, typically fabricated from silicon. Its fabrication method is comprised in the claims (claim 25, 33 to 36). First a metallic layer is deposited on one face of the substrate. Then pores, i.e cavities are etched through the whole substrate either by electrochemical etching (deep anodic or photo-anodic etching; claim 26) or by plasma etching (claim 27). The fabrication method of the etched cavities is not an essential **part of the invention**. The catalyst material is then deposited by vacuum evaporation techniques such as chemical vapour deposition (CVD) on the inner walls of the etched pores. We refer to a so processed structure in this patent as hydrogen reforming reactor segment or unit. By use of the pre-defined alignment marks (claim 28) several of these reactor elements can be

a) either stacked on top of each other forming a hydrogen reforming reactor (see Fig. 1a +b in Apendix)

b) two rector elements can be combined to and oppositely aligned to an "interdigit" structure schematically depicted in Fig. 2 in Appendix . This strcture is well suited to the envisaged application of steam reforming reactor which creates hydrogen for fuel cell systems.

Should further issues remain prior to allowance, the Examiner is respectfully requested to contact the undersigned at the indicated telephone number.

Respectfully submitted,

_____

Hartmut Presting

Date: **February 9, 2009**

Tel. +49-1608620820 (mobile) +49-731-9502438 (daytime home office)
Fax : +49-731-9502439